

REMARKS

This application has been carefully reviewed in light of the Office Action dated July 29, 2003. Claims 13 and 41-43 have been amended. Applicants respectfully request reconsideration of the above-referenced application in light of the amendments and following remarks.

Claims 13, 14, 16, 17 and 41-43 stand rejected under 35 U.S.C. § 112, first paragraph as allegedly failing to meet the written description requirement. The rejection is respectfully traversed and reconsideration is requested.

Claims 13 and 41-43 have been amended to overcome the Examiner's concerns. Specifically, the claims have been amended to omit that the rapid thermal process chamber is "less than atmospheric pressure." Claims 14, 16 and 17 depend from independent claim 13. Accordingly, withdrawal of the § 112, first paragraph rejection is solicited.

Claims 13, 14, 17, 42 and 43 stand rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by Miner. The rejection is respectfully traversed and reconsideration is requested.

Miner does not anticipate the claimed invention. Miner does not teach a method of "depositing a dielectric film . . . and subjecting the dielectric film to a wet oxidation with steam process . . . by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature greater than about 450 °C, wherein said mixture is a ratio from approximately 0.1 to approximately 0.80 of hydrogen gas to oxygen gas, and wherein the ratio of said mixture relative to other gases in said chamber is in the range from about 0.1 to about 0.5," as recited in claim 1 (emphasis added), or a method of "depositing a dielectric film . . . and subjecting the dielectric film to a wet oxidation with steam process . . . by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature greater than about 450 °C, wherein said mixture is a ratio from approximately 0.1 to approximately 0.80 of hydrogen gas to oxygen gas, and wherein the pressure of said rapid thermal process chamber is about atmospheric pressure,"

as recited in claim 42 (emphasis added), or a method of “depositing a non-crystalline dielectric film . . . and subjecting the non-crystalline dielectric film to a wet oxidation with steam process . . . by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature from about 450 °C to about 750 °C, said mixture is a ratio from approximately 0.1 to approximately 0.80 of hydrogen gas to oxygen gas, wherein said steam is provided in a ratio of at least 0.005 relative to other gases present in the rapid thermal process chamber,” as recited in claim 43(emphasis added).

Miner teaches in Step 304 a stabilization process carried out by heating the silicon substrate 100 (See Col. 8, lines 5-10). The stabilization step 304 yields a crystalline film. Miner does not teach a method of “depositing a non-crystalline dielectric film . . . and subjecting the non-crystalline dielectric film to a wet oxidation with steam process,” as recited in claim 43 (emphasis added). Further, Miner does not teach that the mixture of hydrogen to oxygen gas “relative to other gases in said chamber is in the range from about 0.1 to about 0.5,” as recited in claim 13 (emphasis added). In fact, Miner does not even teach or suggest the ratio of hydrogen to oxygen gas relative to other gases in a rapid thermal process chamber. Still further, Miner does not teach that “the pressure of said rapid thermal process chamber is about atmospheric pressure,” as recited in claim 42 (emphasis added). Miner merely teaches a pressure of 150 Torr of chamber 213 at a process temperature of 950°C (See Col. 8, lines 45-48). Atmospheric pressure is about 760 Torr, a significant difference from 150 Torr.

Claims 14 and 17 depend from claim 13 and are allowable for similar reasons along with claim 13. Accordingly, Miner does not anticipate Applicants’ invention. Withdrawal of the § 102(e) rejection for claims 13, 14, 17, 42 and 43 is respectfully solicited.

Claims 13, 14, 16, 17, and 41-43 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Luan in view of Tseng. The rejection is respectfully traversed and reconsideration is requested.

Claim 13 recites a method of “depositing a dielectric film . . . and subjecting the dielectric film to a wet oxidation with steam process . . . by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature greater than about 450 °C, wherein said mixture is a ratio from approximately 0.1 to approximately 0.80 of hydrogen gas to oxygen gas, and wherein the ratio of said mixture relative to other gases in said chamber is in the range from about 0.1 to about 0.5.” (emphasis added).

Claim 41 recites a method of “depositing a dielectric film with a thickness greater than about 40 Angstroms . . . and subjecting the dielectric film to a wet oxidation with steam process . . . in a rapid thermal process chamber at a temperature greater than about 450 °C, said steam provided in a ratio of at least 0.005 relative to other gases present in the rapid thermal process chamber, wherein the pressure of said rapid thermal process chamber is about 1 millitorr.” (emphasis added).

Claim 42 recites a method of “depositing a dielectric film . . . and subjecting the dielectric film to a wet oxidation with steam process . . . by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature greater than about 450 °C, wherein said mixture is a ratio from approximately 0.1 to approximately 0.80 of hydrogen gas to oxygen gas, and wherein the pressure of said rapid thermal process chamber is about atmospheric pressure.” (emphasis added).

Claim 43 recites a method of “depositing a non-crystalline dielectric film . . . and subjecting the non-crystalline dielectric film to a wet oxidation with steam process . . . by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature from about 450 °C to about 750 °C, said mixture is a ratio from approximately 0.1 to approximately 0.80 of hydrogen gas to oxygen gas, wherein said steam is provided in a ratio of at least 0.005 relative to other gases present in the rapid thermal process chamber.” (emphasis added).

Luan merely teaches “[t]he Ta₂O₅ gate stack was fabricated by *in-situ* RTP multiprocessing” (Experiment Paragraph). Then, Luan teaches that “post-deposition annealing is performed in O₂ or H₂/O₂ ambient at 600°C to improve film quality and

reduce leakage current.” (Experiment Paragraph). Luan does not teach or suggest subjecting a dielectric film to “a wet oxidation with steam process,” as recited in claims 13, 41, 42 and 43. In fact, Luan does not even teach or suggest that steam is even created in the post-deposition annealing process. There is no suggestion whatsoever that Luan is directed to a wet oxidation with steam process.

The Office Action asserts that Luan teaches that “the pressure of said rapid thermal process chamber is inherently less than atmospheric pressure.” (Office Action, pg. 4). Applicants respectfully submit that Luan does not teach or suggest a pressure for the rapid thermal process chamber. Luan does not teach or suggest the ratio of hydrogen to oxygen. Luan does not teach or suggest the ratio of the hydrogen and oxygen steam mixture relative to other gases in the rapid thermal process chamber. Luan does not teach or suggest that the wet oxidation process is carried out for a “duration of about 20 seconds to about 60 seconds,” as recited in claim 14. Luan teaches that the *in-situ* RTP fabrication process for Ta₂O₅ stacked gate dielectrics takes more than 300 seconds (See Luan’s Fig. 1).

Tseng is relied upon for teaching a wet oxidation temperature in the range of 750-950°C, a ratio of H₂:O₂ of about 0.1 to about 0.8, and that the rapid thermal process chamber is less than atmospheric pressure.

First, Tseng teaches that “the percentage of H₂ in the O₂ and H₂ mixture [is] approximately 6%, however a range of approximately 3% to 9% is expected to obtain comparable results.” (Col. 6, lines 60-63). Tseng does not teach or suggest Applicants’ claimed H₂:O₂ ratio. The Office Action asserts that “Tseng does however teach that the ratio may be 0.093 which is significantly close to 0.1.” (Office Action, pg. 8). However, Applicants respectfully points out that on page 6 of the Office Action, the Examiner alleges that 0.093 is the ratio of steam relative to the other gases in the rapid thermal process chamber and not the ratio of H₂:O₂. Further, Tseng clearly teaches a range of 3% to 9% and not Applicants’ claimed ratio of H₂:O₂ of about 0.1 to about 0.8 as recited in claims 13, 42 and 43. This fact is underscored since Tseng discloses that “a range of approximately 3% to 9% is expected to obtain comparable results.” (Col. 6, lines 60-63) (emphasis added). There is no motivation to deviate from the 3% to 9% range.

Second, Tseng does not teach or suggest that the rapid thermal process chamber is about 1 millitorr or about atmospheric pressure. In fact, Tseng does not even teach or suggest a pressure for the rapid thermal process chamber. Further, although Tseng may disclose a wet oxidation ambient, Tseng does not teach or suggest that this is a wet oxidation with steam process carried out in a rapid thermal process chamber. Thus, Tseng does not teach or suggest that the pressure of the rapid thermal process chamber is about 1 millitorr as recited in claim 41 or about atmospheric pressure as recited in claim 42.

Finally, Tseng and Luan teach away from each other. Luan teaches an oxidation temperature of 600°C, Tseng teaches an oxidation temperature in the range of 750-950°C. Luan teaches post-deposition annealing performed in an O₂ or H₂/O₂ ambient. This is not the same as Tseng's wet oxidation ambient. Luan teaches a post-deposition annealing time of approximately 300 seconds. Tseng teaches that the wet oxidation exposure occurs for preferably about 15 minutes and can be changed from about 10 minutes to an hour (Col. 5., lines 62-65). Thus, Tseng teaches an oxidation time twice as long as Luan. There is simply no motivation to combine Tseng's teachings with Luan since the parameters of the oxidation is so different between the two references.

The Office Action asserts that it would be a matter of routine optimization to determine the optimum ratio of hydrogen to oxygen and temperature. The Office Action then concludes that the Applicants have not provided any evidence that the claimed ratio provides unexpected results relative to that used in Luan in view of Tseng (Office Action, pg. 7).

At the outset, Applicants respectfully submit that the Office Action has not set forth a *prima facie* case of obviousness. See M.P.E.P. § 2143. There is no teaching or motivation to combine the Tseng and Luan since they clearly teach different oxidation parameters. "The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." M.P.E.P. § 2143 (emphasis added). The Applicants respectfully submit that the combination of Tseng and Luan is impermissible hindsight.

Further, Tseng and Luan do not teach or suggest all of the claim limitations. Luan and Tseng do not teach or suggest that the wet oxidation process is carried out for a “duration of about 20 seconds to about 60 seconds,” as recited in claim 14, or that the ratio of the hydrogen and oxygen steam mixture “relative to other gases in said chamber is in the range from about 0.1 to about 0.5,” as recited in claim 13, or that “the pressure of said rapid thermal process chamber is about 1 milliTorr,” as recited in claim 41, or that “the pressure of said rapid thermal process chamber is about atmospheric pressure,” as recited in claim 42, or that the ratio of hydrogen to oxygen gas is “from approximately 0.1 to approximately 0.80,” as recited in claim 13, 42, and 43, or that the ratio of the hydrogen to oxygen gas “relative to other gases in said chamber is in the range from about 0.1 to about 0.5,” as recited in claim 13.

Claims 14 and 16-17 depend from independent claim 13. For at least these reasons, claims 14 and 16-17 are allowable along with claim 13. Accordingly, withdrawal of the § 103(a) rejection for claims 13, 14, 16-17, and 41-43 is respectfully solicited.

Claim 14 further recites that the “wet oxidation is performed at a temperature in a range of about 750°C to about 950°C.” Luan illustrates in FIGS. 2, 4, and 6, a Ta₂O₅/Al gate. Tseng discloses that it is not possible to perform an oxidation step to cure plasma etch damage when a metal gate is employed, which is specifically taught in Luan. Luan teaches employing an aluminum gate. Tseng teaches that “[a]t temperatures higher than 520°C . . . aluminum gates would be destroyed, degraded, severely oxidized .” (Col. 3, lines 1-8). Thus, even if the references are combinable, one skilled in the art would not perform a wet oxidation higher than 600°C since Tseng teaches that higher temperatures, e.g., above 520°C, degrade metal gates. Accordingly, the cited references would not suggest a wet oxidation anneal in a temperature range of “750°C to about 950°C.” This is an additional reason for the allowance of claim 14.

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In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,

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